

**2004
WHITLOCKS BAY SPAWNING STATION
ANNUAL REPORT**

**South Dakota
Department of
Game, Fish and Parks
Wildlife Division
Joe Foss Building
Pierre, South Dakota 57501-3182**

**Progress Report
No. 05-01**

PREFACE

This report discusses the data collected during the Chinook salmon spawning season in 2004 and previous data showing trends during 20 years of station operation. The author would like to acknowledge all those who assisted with spawning operations, data collection, and maintenance of the facility in 2004. The author would like to thank John Aberle, Brian Beel, Butch Schunot, Aaron Leingang, and Kyle Potter for assisting with the coded-wire-tag (CWT) reading and boat electrofishing.

Summary Table

Summary of Spawn-Taking Effort in 2004					
Species	Number shocked	Females spawned	Eggs taken	Total cost of spawn	Cost per 1000 eggs
Chinook salmon	170	18*	33,120	----	----

*Does not include green, spent, or over-ripe females spawned

The table represents spawning operations that typically occur at Whitlocks Bay Spawning Station. However due to low water conditions, salmon were spawned in the back of Spring Creek. Rainbow trout were not included in this table because the station was not being operated during the spring.

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Introduction

In the early 1970's, the South Dakota Department of Game, Fish and Parks attempted to develop a salmonid sport fishery in Lake Oahe that would utilize the lake's coldwater habitat and diversify the existing fishery. Introductions of kokanee salmon, Bonneville cisco, opossum shrimp, lake herring and lake whitefish were made in hopes of establishing a prey base for a large predator species. These stockings, except for lake trout, were generally unsuccessful. Lake trout were selected because of the possibility that sufficient natural reproduction might occur to maintain a fishery without the need for annual maintenance stockings. However, minimal success was achieved with this species and no natural reproduction of this species was documented. In 1971, 7,500 adult Lake Superior rainbow smelt were stocked into Lake Sakakawea North Dakota and by 1976 smelt had established a self-sustaining population in downstream Lake Oahe. Chinook salmon had also reached Lake Oahe, as early as 1979, from Lake Sakakawea. As a result of the success of Lake Sakakawea rainbow smelt and Chinook salmon introductions, the South Dakota Department of Game, Fish and Parks implemented its own Chinook salmon program in 1982.

Chinook salmon from the Little Manistee Hatchery in Michigan and a hatchery in Wisconsin had been stocked as smolts into Lake Sakakawea, North Dakota in 1978. The origination of these Great Lakes Chinook were from two ocean-run strains from the state of Washington. The first was a 'Tule' strain Chinook which migrated up the Columbia River and spawned in the feeder streams of the Cascade Mountain Range at Spring Creek Hatchery. The second was a Puget Sound strain from Washington's Green River Hatchery. After three years of successful planting of smolts from these West Coast eggs, Michigan became self-sufficient for Chinook salmon production. By 1979 Chinook salmon stocked in Lake Sakakawea had reached Lake Oahe and by 1981 they were abundant enough that South Dakota Department of Game, Fish and Parks personnel collected 100,000 eggs from 54 female Chinook salmon at Whitlocks Bay, Lake Oahe, SD, October 19-22, 1981. Cleghorn Springs Hatchery incubated the eggs and produced 31,280 smolts which were stocked in Whitlocks Bay, April 1982. An additional 260,870 smolts produced from Lake Michigan eggs were also stocked in Lake Oahe. South Dakota has been relatively self-sufficient for salmon eggs since 1984.

The purpose of Whitlocks Bay Spawning Station (WBS) is to collect spawning adults of Chinook salmon and rainbow trout so that annual egg-production needs could be met, and a sport fishery in Lake Oahe could be maintained. Artificial propagation of Chinook salmon and rainbow trout is necessary because suitable spawning habitat is not available in Lake Oahe's warm and turbid incoming tributaries. The station has also been used to collect brown trout eggs; however, brown trout have not been stocked in Lake Oahe since 1990. Brown trout have not returned to the station since 1994.

Construction of Whitlocks Bay Spawning Station began in 1982 and the station was fully operational in April, 1984. The station is located 18 miles west of Gettysburg on Lake Oahe at Whitlocks Bay (Figure 1). The Whitlocks Bay Spawning Station consists of a fish ladder (artificial stream), four concrete holding ponds (45'X 8'X 4'), a crowding raceway, a 28'X 48' spawning building, and a water supply system (Figure 2). Two submersible pumps, capable of delivering a total of 2,600 gallons of water per minute (depending on lake elevation), are

mounted on skids that are pushed into the reservoir before the pumping season and removed when not in use. Water is pumped from the bay into the station where it gravity flows through raceways and down the fish ladder into the reservoir. The station is typically operated from approximately September 15th through the first week of November. Personnel needed at the facility include a manager and a conservation technician. Considerable time is spent explaining department fisheries programs and providing guided tours to the public. In the fall, four to six additional people are needed during days of salmon egg collection.

This report discusses the 2004 Chinook salmon spawn and previous data showing trends during the twenty years of station operation. For a summary of previous operations, refer to annual reports for the years 1984-2003.

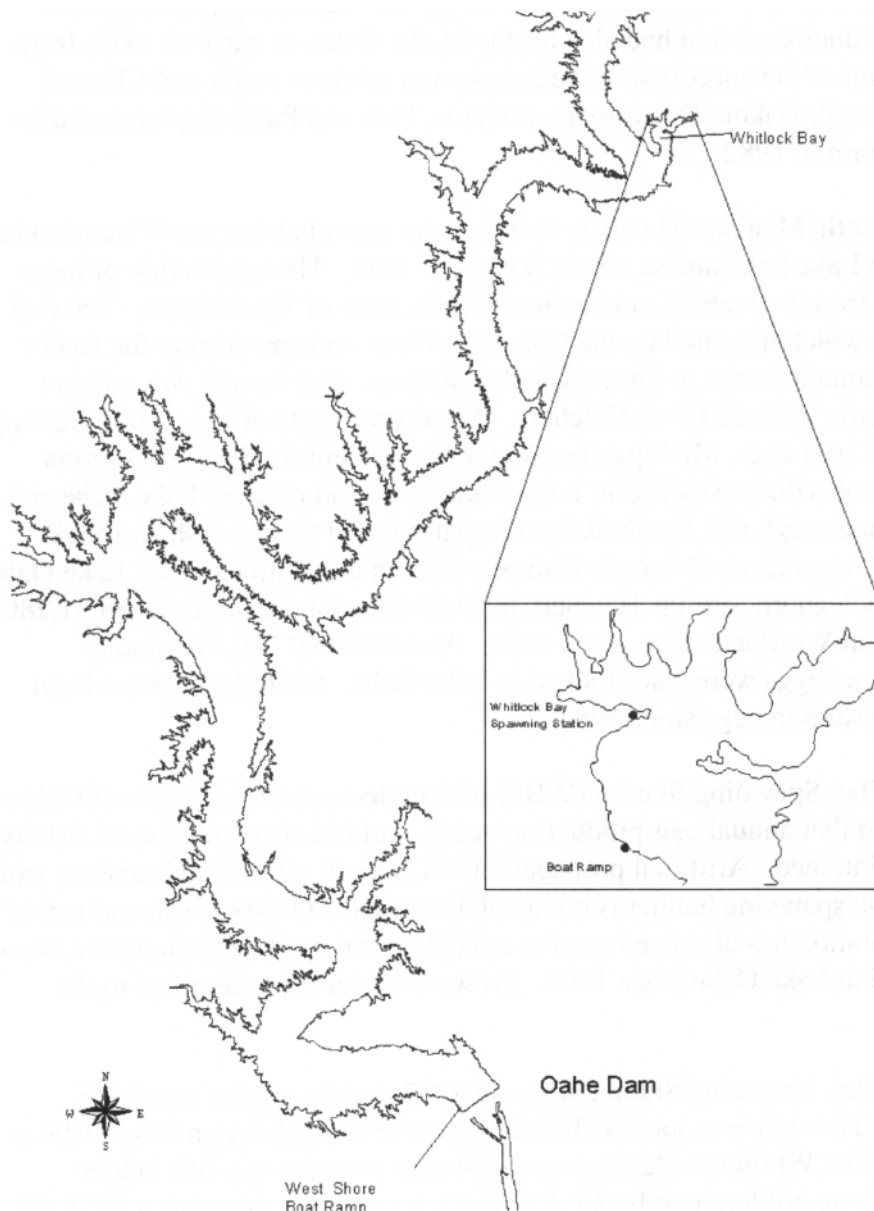


Figure 1. Location of Whitlocks Bay Spawning Station. 2

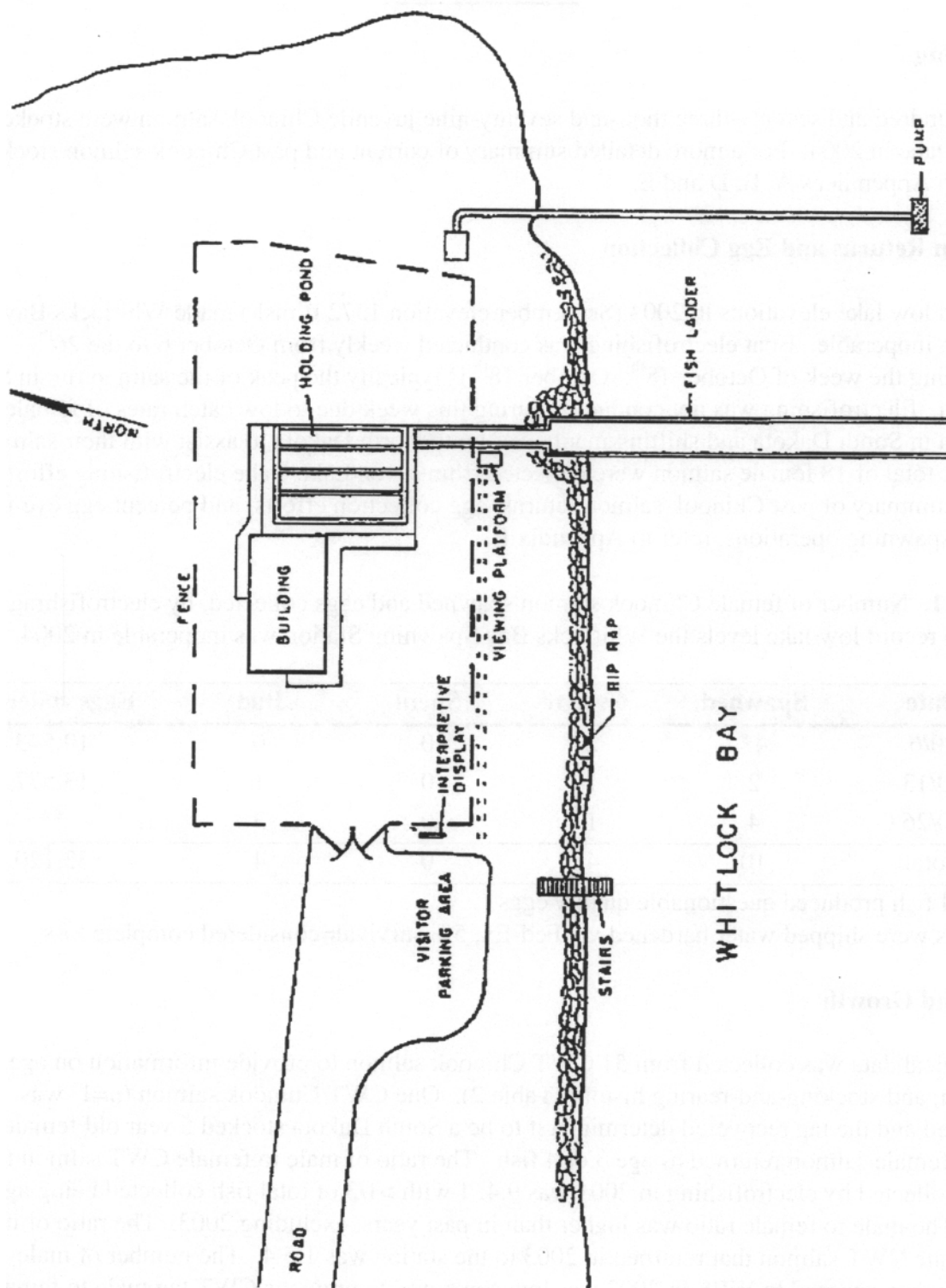


Figure 2. General layout of Whitlocks Bay Spawning Station 3

Chinook Salmon

Stocking

One hundred and seventy-three thousand seventy-nine juvenile Chinook salmon were stocked in Lake Oahe in 2004. For a more detailed summary of current and past Chinook salmon stockings, refer to Appendices A, B, D and E.

Station Returns and Egg Collection

Record low lake elevations in 2004 (September elevation 1572 ft.msl.) made Whitlocks Bay Station inoperable. Boat electrofishing was conducted weekly from October 6 to the 26th excluding the week of October 18^h. October 18^h is typically the peak of the salmon run in South Dakota. Electrofishing was not conducted during this week due to low catch rates of female salmon in South Dakota and shifting manpower up to North Dakota to assist with their salmon run. A total of 18 female salmon were collected from seven Lake Oahe electrofishing efforts. For a summary of past Chinook salmon returns, egg collection efforts, and percent egg eye-up for WBS spawning operations, refer to Appendix E.

Table 1. Number of female Chinook salmon spawned and eggs collected, by electrofishing only. Due to record low lake levels the Whitlocks Bay Spawning Station was inoperable in 2004.

Date	Spawned	Green	Spent	Bad	Eggs collected
10/6	4*	2	0	0	19,543
10/13	2	1	0	1	13,577
10/26	4	1	0	3	**
Total	10	4	0	4	33,120

*2 of 4 fish produced questionable quality eggs.

**Eggs were shipped water hardened via Fed-Ex, 5% survival=considered complete loss.

Age and Growth

Biological data was collected from 51 CWT Chinook salmon to provide information on age, growth, and stocking-and-rearing history (Table 2). One CWT Chinook salmon (n=1) was captured and the tag recovered determined it to be a South Dakota stocked 5 year old female. No CWT female salmon returned as age 3 or 4 fish. The ratio of male to female CWT salmon that were collected by electrofishing in 2004 was 9.4: 1 with >1/3 of total fish collected being age 2 fish. The male to female ratio was higher than in past years, excluding 2003. The ratio of male to female CWT salmon that returned in 2003 to the station was 1:5.4. The number of male salmon that returned to WBS in 2003 was low compared to previous CWT tag male to female ratios of 4.1:1 and 3.4:1 in 2000 and 2001. The 2004 run was dominated by male chinook salmon maturing and spawning as 2 year old fish. The age composition of 2 and 3 year male CWT salmon have composed up to 100% of total CWT males returning to the station during a spawn (Marrone and Stout 1995). The average weight of age 2 male chinook salmon increased

to 1,544 grams in 2004 from 715 grams in 2001 and was above the twenty year average of 1,462 grams (Figure 3).

Table 2. Age composition, length and weight of 51 coded-wire tagged Chinook salmon collected by electrofishing, fall 2004.

*Female weight is post-spawn.

Age	Sex	Brood year	Number	Mean length (mm)	Range	Mean weight* (g)	Range
1	Male	2003	1	289	-----	283	-----
2	Male	2002	49	490	255-814	1,550	263-3315
3	Male	2001	0	-----	-----	-----	-----
	Female		0	-----	-----	-----	-----
4	Male	2000	0	-----	-----	-----	-----
	Female		0	-----	-----	-----	-----
5	Male	1999	0	-----	-----	-----	-----
	Female		1	822*	-----	-----	-----

One of the coded wire tagged salmon was a fish stocked in Lake Sakakawea, North Dakota.

A breakdown of the total number, size at stocking, and number of CWT salmon stocked in Lake Oahe, South Dakota from 1997 to the present can be found in Appendix G. In addition, South and North Dakota CWT codes and numbers of all tagged fish, can be found in Appendices E and F. Detailed breakdowns of treatment groups, number of fish marked, and research purposes behind marking can be found in Appendix I. A complete summarization and analyses of CWT returns from 1987 - 1996 can be found in a report by Lott et al. (1997).

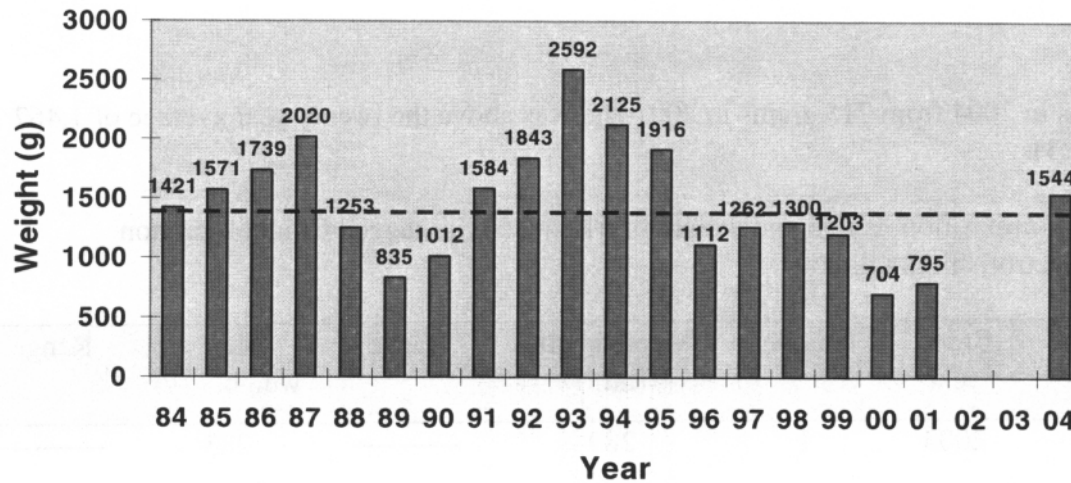


Figure 3. Average weight of age-2 Chinook salmon collected and spawned from 1984 - 2004 returns to Whitlocks Bay Spawning Station and collected by fall electrofishing. The dotted line represents mean weight (1,462 g) of age-2 salmon.

Contribution of North Dakota Salmon

Of the 51 CWT Chinook salmon captured by electrofishing in 2004, eight were from North Dakota. A percentage was determined using the known number of North Dakota fish tagged from each stock and calculating a percent return from the number (captured in the South Dakota portion of Lake Oahe) of North Dakota fish spawned in South Dakota. In 2004 it was estimated that 72 (i.e., approximately 42%) of the 170 salmon captured were North Dakota fish. This estimate provides a very rough picture of the contribution of North Dakota salmon to the South Dakota Chinook salmon spawn.

Estimated contributions of North Dakota fish from 1998 to 2003 have ranged anywhere from 0 to 10%. In 2004, observational data combined with coded-wire-tag verification revealed that all but one of the mature females and all >10 lb. males originated from Lake Sakakawea. This coincides with the total number of South Dakota stocked salmon available to spawn being limited to \leq age 2 males and age 5 females.

In 2003 and 2004, Lake Sakakawea reservoir levels and Garrison dam water releases probably increased the abundance of North Dakota salmon in Lake Oahe. The large percentage of non-imprinted CWT North Dakota salmon in 1998 and 1999 are probably related to high water releases from Garrison Dam in 1996 and 1997 and these salmon likely contributed to the large number of fish that were straying into bays in an attempt spawn. This cannot be quantified because in years when the station was operated and fish were collected by electrofishing tagged salmon captured by electrofishing were not individually analyzed to determine the straying ratio of North Dakota versus South Dakota fish.

Tri-State Chinook Salmon Egg Take and Inter-State Assistance

With few outside sources for disease free Chinook salmon eggs and large scale annual fluctuations in the number and quality of salmon eggs collected in Lake Oahe, Lake Sakakawea, and Fort Peck reservoirs, tri-state cooperation is a necessity. This cooperation has come in the form of many things (i.e., sharing of CWT machines, research results, manpower, etc.) with the most obvious form of cooperation being the transfer of Chinook salmon eggs or fry/fingerlings among states when needed. A complete summary of South Dakota, North Dakota, and Montana Chinook salmon total egg take and inter-state egg, fry and fingerling transfers can be found in Appendix N. It is hoped that tri-state cooperation will continue and expand as the popularity of salmon fisheries on the prairie mainstem Missouri River reservoirs expands.

Past stocking records of Chinook salmon for Lake Oahe are presented in Appendix A, B, D and E and a summary of past salmon returns and egg collection efforts can be found in Appendix C. A cost breakdown was not completed in 2004 because the station was not operated (Table 3).

Table 3. Costs of taking Chinook salmon eggs at Whitlocks Bay Spawning Station, 2004.

Manpower/per diem/travel	NC
Utilities	NC
Miscellaneous-pump removal, hardware, etc	<u>NC</u>
Total Costs	NC
Number of eggs taken	NC
Cost/1,000 eggs collected	\$ NC

NC=Costs of operation were not completed because Whitlocks Bay Spawning Station was not operated in 2004 due to record low lake elevations and expected low salmon returns.

Visitation and Tours

The Whitlocks Bay Spawning Station did not operate during the fall of 2004.

Literature Cited

Haskell, D. G. 1959. Trout growth in hatcheries. New York Fish and Game Journal 5:204-237.

Lott, J., G. Marrone, D. Stout 1997. Influences of size-and-date at stocking, imprinting attempts and growth on initial survival, homing ability, maturation patterns and angler harvest of Chinook salmon in Lake Oahe, SD. South Dakota Department of Game, Fish and Parks, Wildlife Division, Report 97-20, Pierre.

Marrone, G., M. and D. A. Stout 1995. 1995 Whitlocks Bay Spawning Station Annual Report. South Dakota Department of Game, Fish and Parks, Wildlife Division , Report, Pierre.

Appendix A. Numbers of coldwater fish stocked in Lake Oahe by species, 1983 - 2004.

Year	Brown Trout	Chinook Salmon	Lake Trout	Rainbow Trout	Lake Herring
1983	-----	790,150	7,779	131,395	-----
1984	18,000	784,550	8,560	279,395	470,000
1985	69,000	845,542	4,750	85,635	-----
1986	52,900	811,665	-----	146,229	-----
1987	93,700	1,005,054	-----	50,000	-----
1988	77,167	1,061,535	-----	41,270	200
1989	50,000	217,037	-----	19,150	-----
1990	50,500	66,385	-----	32,370	9,388,500
1991	-----	249,478	-----	18,410	10,995,500
1992	-----	219,000	-----	27,190	11,416,000
1993	-----	275,055	-----	74,707	-----
1994	-----	298,759	-----	81,365	-----
1995	-----	363,787	-----	96,002	-----
1996	-----	418,478	-----	145,659	-----
1997	-----	396,660	-----	118,958	-----
1998	-----	234,101	-----	131,245	-----
1999	-----	104,976	-----	213,506	-----
2000	-----	49,494	-----	101,021	-----
2001	-----	-----	-----	-----	-----
2002	-----	-----	-----	-----	-----
2003	-----	17,259	-----	-----	-----
2004	-----	173,079	-----	-----	-----
Total	411,267	8,318,664	21,089	1,793,507	32,270,200
Average	58,752	415,933	7,030	99,639	6,454,040

Appendix B. Pounds and kilograms of coldwater fish stocked in Lake Oahe by species, 1982 – 2004.

Year	Brown Trout		Chinook Salmon		Lake Trout		Rainbow Trout		Steelhead Trout		Total	
	(lbs.)	(kg.)	(lbs.)	(kg.)	(lbs.)	(kg.)	(lbs.)	(kg.)	(lbs.)	(kg.)	(lbs.)	(kg.)
1982	----	----	2,169	984	1,373	623	1,988	902	40	18	5,570	2,527
1983	----	----	8,889	4,032	1,903	863	1,532	695	----	----	12,324	5,590
1984	1,385	632	11,266	5,110	2,094	950	12,541	5,689	----	----	27,286	12,377
1985	4,182	1,908	11,882	5,390	1,041	472	1,691	767	430	195	19,226	8,721
1986	5,290	2,414	11,132	5,049	----	----	7,901	3,584	6,256	2,838	30,579	13,871
1987	4,462	2,036	15,754	7,146	----	----	----	----	12,500	5,670	32,716	14,840
1988	5,599	2,555	13,810	6,264	----	----	----	----	8,351	3,788	27,760	12,592
1989	3,378	1,541	9,299	4,218	----	----	----	----	2,217	1,006	14,894	6,756
1990	3,389	1,546	2,417	1,096	----	----	----	----	----	----	13,899	6,305
1991	----	----	8,473	3,843	----	----	8,093	3,671	----	----	12,083	5,481
1992	----	----	5,300	2,404	----	----	3,610	1,637	----	----	8,453	3,834
1993	----	----	7,348	3,333	----	----	5,257	2,385	----	----	12,605	5,718
1994	----	----	8,169	3,705	----	----	6,732	3,054	----	----	14,901	6,759
1995	----	----	9,922	4,501	----	----	9,973	4,524	----	----	19,895	9,024
1996	----	----	10,893	4,941	----	----	10,022	4,546	----	----	20,915	9,487
1997	----	----	5,053	2,292	----	----	9,492	4,306	----	----	14,545	6,598
1998	----	----	9,428	4,277	----	----	8,942	4,056	----	----	18,370	8,333
1999	----	----	7,608	3,451	----	----	14,647	6,644	----	----	22,255	10,095
2000	----	----	6,240	2,830	----	----	6,937	3,147	----	----	13,177	5,977
2001	----	----	----	----	----	----	----	----	----	----	----	----
2002	----	----	----	----	----	----	----	----	----	----	----	----
2003	----	----	1,121	508	----	----	----	----	----	----	1,121	508
2004	----	----	3,882	1,761	----	----	----	----	----	----	3,882	1,761
Total	27,685	12,633	170,679	77,420	6,411	2,908	112,511	51,035	29,794	13,515	347,080	157,435
Average	3,955	1,805	8,128	3,687	1,603	727	7,032	3,190	4,966	2,252	16,528	7,497

Totals and averages were calculated from years when fish were stocked.

Appendix C. Summary of salmon returns and egg collections at Whitlocks Bay Station, 1984-2004.

Year	Total salmon returned	Number of females spawned	Number of good eggs	Average number of eggs/female	Percent egg eye-up
1984	175	29	81,340	2,800	----
1985	435	119	364,900	3,066	----
1986	484	61	186,746	3,061	----
1987	1,034	187	871,137	4,659	----
1988	1,320	270	667,796	2,473	----
1989	1,256 ^a	227	418,160	1,842	37
1990	1,107	409	787,708	1,926	40
1991	1,343	193	453,864	2,352	60
1992	690 ^b	319	992,630	3,112	40
1993	1,354	449	1,744,100	3,884	53
1994	2,749	408	1,542,180	3,780	44
1995	3,664	527	1,969,162	3,737	48
1996	1,133	355	1,054,841	2,971	74
1997	673 ^c	193	558,945	2,896	53
1998	422 ^d	211	498,100	2,361	48
1999	328 ^e	124	316,862	2,555	70
2000	283	74	155,700	2,100	49
2001	468	67	153,264	2,286	31
2002	727	189 ^f	724,380 ^f	3,833 ^f	57 ^f
2003	459	284	1,168,978	4,116	48
2004	170 ^g	18	33,120	1,840	--
Total	20,104	4,695	14,710,793	59,810	--
Average	1,005	235	735,540	2,991	50

includes 71 females and 121 males from Spring Creek, Sutton Bay and Whitlocks Bay.

^bincludes 307 females from East Shore, Cow/Spring Creek and Cheyenne Creek

^cincludes 124 females and 33 males from Cow/Spring/Okobojo Crks., Sutton Bay, & Cheyenne Creek

^dincludes 131 females from Cow/Spring Creeks, West Shore, Sutton and Whitlocks Bay ^eincludes 76 females from Cow/Spring Creeks and Sutton and Whitlocks Bay

^fdoes not include 134 females eggs stripped and fertilized at hatchery (467,992 eggs collected 11% eye-up) gall of the fish collected were electrofished from Cow/Spring, Sutton and Whitlocks Bay

Appendix D. Chinook salmon stocked in Lake Oahe, South Dakota by number, size and mark, 1998 -2004.

Date	Number	Strain	Hatchery	No./lb.	Mark	Fin clips	Location
04/27/98	35,070	O	BD	105	None	None	WB
05/27/98	26,075	O	BD	35.0	None	None	WB
06/02/98	28,822	O	MN	34.5	CW	AD	WB
06/02/98	97,292	O	MN	37.7	None	None	WB
09/23/98	18,461	O	MN	9.4	CW	AD	WB
09/30/98	28,381	O	MN	9.6	None	None	WB
06/02/99	15,745	O	MN	40.24	CW	AD	WB
06/02/99	14,519	O	MN	43.13	CW	AD	WB
06/10/99	24,508	O	MN	31.9	None	None	WB
09/29/99	19,371	O	MN	8.2	CW	AD	WB
09/29/99	30,873	O	MN	8.2	None	None	WB
07/19/00	7,458	O	MN	16.46	None	None	WB
09/20/00	15,000	O	MN	8.46	CW	AD	WB
09/26/00	19,494	O	MN	8.58	None	None	WB
09/26/00	15,000	O	MN	8.61	CW	AD	WB
2001	0	-	-	-	-	-	-
2002	0	-	-	-	-	-	-
06/02/03	5,688	O	MN	34.76	CW	AD	WB
06/02/03	4,403	O	MN	33.64	CW	AD	WB
10/27/03	4,368	O	MN	8.43	CW	AD	WB
05/11/04	14,295	O	MN	22.67	CW	None	WB
05/11/04	13,528	O	MN	23.93	CW	None	WB
05/26/04	66,254	O	MN	84.4	CW	AD	WB
05/26/04	23,002	O	MN	26.3	None	None	WB
6/01/04	56,000	O	CS	54.8	None	None	WB

CW = coded-wire tagged and adipose fin clipped

AD = adipose fin clipped fish BD = Blue Dog, State

Fish Hatchery MN = McNenny State Fish Hatchery

CS = Cleghorn Springs State Fish Hatchery

Appendix E. South Dakota Chinook salmon coded-wire-tag data 1989 -2004.

Year stocked	Brood year	Description	Number tagged	Number stocked	Tag retention (percent)	Data1	Data2
1990	1989	WBS/Fall Stock (8/lb.)	10,300	-----		17	19
1990	1989	WBS/(53/lb.)	29,019	-----		19	26,27
1991	1989	WBS (2.9/lb.)	11,990	-----		19	24
1991	1989	OATW (2.9/lb.)	5,254	-----		19	25
1991	1990	WWB Direct Stock (45/lb.)	19,242	-----		20	28,29,30
1991	1990	WBS Stock	17,850	-----		20	31,32,33,34
1992	1991	WWB (30/lb.)	30,193	-----	89.5%	21	1,2
1992	1991	WWB (runts)	2,623	-----	86.0%	21	3
1993	1992	WWB (34/lb.)	22,959	-----	92.5%	22	1,2,3
1993	1992	WWB (51/lb.)	18,430	-----	80.0%	22	4,5,6,7
1994	1993	WWB (29.6/lb.)	47,973	210,656	82.8%	23	1,2,3,4,5,6
1995	1994	WWB (27.9/lb.)	48,469	212,999	98.0%	24	1,2,3,4,5,6
1996	1995	WWB (32.5/lb.)	46,394	237,217	86.0%	25	1,2,3,4,5,6
1997	1996	WWB (38.9/lb.)	50,428	243,278	80.5%	26	1,2,3,4,5,6
1998	1997	WWB (34.5/lb.)	28,822	126,144	82.1%	27	1
1998	1997	WWB (9.41/lb.)	19,315	47,696		27	2
1999	1998	WWB (43.13/lb.)	14,519	54,772	99%	28	1
1999	1998	WWB (40.24/lb.)	15,745	54,772	97.1%	28	2
1999	1998	WWB (8/lb.)	9,686	50,204	98.6%	28	3
1999	1998	WWB (8.12/lb.)	9,685	50,204	98.3%	28	4
2000	1999	WWB (8.61/lb.)	14,850	24,597	99%	29	1
2000	1999	WWB (8.46/lb.)	14,835	24,582	98.9%	29	2
2001	-----	-----	None	None	-----	-----	-----
2002	-----	-----	None	None	-----	-----	-----
2003	2002	WWB (33.64/lb.)	4,403	4,403	87.5%	25, 28	8,6
2003	2002	WWB (34.76/lb.)	5,688	5,688	39.2%	22	6,8
2003	2002	WWB (8/lb.)	4,368	4,368	25.1%	22	9
2004	2003	WWB (23.93/lb.)	13,528	13,528	82.0%	29	3
2004	2003	WWB (22.67/lb.)	14,295	14,295	83.3%	29	4
2004	2003	WWB (84.4/lb.)	6,303	66,254	None	26	11

Appendix F. North Dakota Chinook salmon coded-wire-tag data 1993 -2004.

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Year stocked	Brood year	Description	Number tagged	Number stocked	Data1	Data2
1994	1993	Cage reared (28/lb.)	15,000	75,000	28	7
1994	1993	GDNFH (37/lb.)	15,000	204,500	28	1
1994	1993	Cage reared (34/lb.)	15,000	123,000	28	3
1995	1994	Cage reared (36/lb.)	13,500	74,000	24	2
1995	1994	GDNFH (8/lb.)	13,500	23,665	24	6
1995	1994	Cage reared (35/lb.)	13,500	130,000	24	14
1995	1994	GDNFH (33/lb.)	13,500	137,247	30	8
1996	1995	Cage reared (49/lb.)	13,000	120,000	30	4
1996	1995	Cage reared (44/lb.)	13,000	79,000	30	5
1996	1995	GDNFH (39/lb.)	13,000	170,000	30	10
1996	1995	GDNFH (44/lb.)	13,000	120,011	30	12
1997	1996	Cage reared (82/lb.)	52,900	38,059	31	1
1998	1997	Small Cage reared (51/lb.)	18,327	70,000	1	2
1998	1997	Large Cage reared (28/lb.)	18,327	69,500	1	5
1998	1997	GDNFH (41/lb.)	18,327	86,482	1	3
1999	1998	GDNFH (96/lb.)	15,900	131,325	60	1
1999	1998	GDNFH (65/lb.)	15,900	92,002	60	2
2000	1999	GDNFH (60/lb.)	15,000	250,000	60	3
2000	1999	GDNFH (90/lb.)	15,000	250,000	60	4
2001	2000	GDNFH (62/lb.)	11,386	255,276	1	72
2001	2000	GDNFH (62/lb.)	602		45	58
2001	2000	GDNFH (62/lb.)	2,012		24	14
2001	2000	GDNFH (106/lb.)	11,248	205,300	1	71
2001	2000	GDNFH (106/lb.)	3,752		30	08
2002	2001	Cage-Rodeo (25/lb.)	14,000	110,007	2	2
2002	2001	Cage-Rodeo (50/lb.)	14,000	98,283	2	1
2002	2001	GDNFH-Rodeo (50/lb.)	14,000	250,554	2	3
2003	2002	GDNFH-Rodeo (27/lb.)	15,000	97,500	2	12
2003	2002	GDNFH-Rodeo (45/lb.)	15,000	202,965	2	11
2004	2003	GDNFH-Rodeo (31/lb.)	14,000	78,000	2	18,19
2004	2003	GDNFH-Rodeo (48/lb.)	14,000	242,818	2	13

Appendix G. Number of coded-wire-tagged Chinook salmon stocked along with treatment and evaluation in Lake Oahe, 1990 – 2004. Number stocked is corrected for tag retention.

Date Stocked	Location	Size (number/lb.)	Number Stocked	Treatment	Purpose
06/08/90	Whitlocks Bay	53.0	29,019	Held at Whitlocks station 25 days	Evaluate stock size and identify
11/01/90	Whitlocks Bay	8.0	7,704	Held at Whitlocks station 15 days.	Known age fish. Evaluate fall
04/24/91	Whitlocks Bay	2.9	9,232	None – direct stock	Stock and identify known age fish.
03/08/91	Oahe Tailwaters	3.0	5,254	None	Evaluate stock size and identify
					Known age and hatchery source.
					Evaluate Oahe Tailwater stocking.
05/15/91	Whitlocks Bay	45.0	17,850	Held at Whitlocks station 14 days.	Compare adults return rate from
05/16/91	Whitlocks Bay	46.2	19,242	None – direct stock.	Smolts held and stocked from
					Whitlocks station.
05/27/92	Whitlocks Bay	29.5	30,193	None – direct stock.	Identify known age fish.
05/27/92	Whitlocks Bay	60.3	2,623	None – direct stock	Determine stocking success and
					Survival of “runts”.
05/25/93	Whitlocks Bay	33.9	22,959	None – direct stock	Identify known age fish. Compare
05/25/93	Whitlocks Bay	50.6	18,430	None – direct stock	Stocking sizes of 34/lb. with 51/lb.
05/23/94	Whitlocks Bay	29.6	47,973	None – direct stock	Identify known age fish.
05/30/95	Whitlocks Bay	27.9	48,469	None – direct stock	Identify known age fish.
05/28/96	Whitlocks Bay	32.5	46,397	None – direct stock	Identify known age fish.
05/27/97	Whitlocks Bay	38.9	50,428	None – direct stock	Identify known age fish.

Appendix G. (continued).

Date stocked	Location	Size (No./lb.)	Code	Number stocked	Treatment	Purpose
06/02/98	Whitlocks Bay	34.5		28,822	None – direct stock	Identify known age fish.
09/23/98	Whitlocks Bay	9.4		18,461	None – direct stock	
06/02/99	Whitlocks Bay	40.2	28-2	15,745	Inside circular tank rearing density <10 kg/m ³	Determine how rearing density and water flows influence post-stocking salmonid survival
06/02/99	Whitlocks Bay	43.1	28-1	14,519	Inside circular tank rearing density >20 kg/m ³	
09/29/99	Whitlocks Bay	8.0	28-3	9,686	Reared in covered raceway at low flow (200gpm)	
09/29/99	Whitlocks Bay	8.1	28-4	9,685	Reared in covered raceway at high flow (>300gpm)	
09/26/00	Whitlocks Bay	8.46	29-2	14,835	Reared in covered raceway at low flow (>100gpm)	Determine how water flows influence post-stocking salmonid survival
09/26/00	Whitlocks Bay	8.61	29-1	14,850	Reared in covered raceway at high flow (>250gpm)	
2001	-----	----	----	-----	Suspended	Studies were suspended until FCS stockings continue due to a prey shortage
2002	-----	----	----	-----	Suspended	
06/02/03	Whitlocks Bay	33.64	22-6,8	3,853	Inside circular tank rearing density <10 kg/m ³	Replicate 1999 Replicate 1999
06/02/03	Whitlocks Bay	34.76	25-8 28-6	2,230	Inside circular tank rearing density >20 kg/m ³	
10/27/03	Whitlocks Bay	8.43	22-9	1,096	Growth/survival data	
05/11/04	Whitlocks Bay	22.67	29-4	11,908	Inside circular tank rearing density <10 kg/m ³	Replicate 1999 Replicate 1999
05/11/04	Whitlocks Bay	23.93	29-3	11,093	Inside circular tank rearing density >20 kg/m ³	
05/26/04	Whitlocks Bay	84.4	26-11	6,303	Rationed feed	Hold back fish experiment-determine Maturation, no tag retention
04/01/05	Whitlocks Bay	80	*	10,000	Growth/survival data	Determine if use of tank covers influence post-stocking salmonid survival
06/01/05	Whitlocks Bay	35	*	10,000	Rear without covers	
06/01/05	Whitlocks Bay	35	*	10,000	Rear under covers to provide refuge areas	
10/15/05	Whitlocks Bay	8	*	6,000	Growth/survival data	

* Code designation not determined yet.

Appendix H. Percent of coded-wire tags returned by anglers and recovered at Whitlocks Bay Spawning Station in Lake Oahe, 1988-2004.

Year stocked	Brood year	Description	Total number stocked	% Tag retention	Corrected #tagged fish	Total No. tagged fish return (fisherman)	Total No. tagged fish return (station)	% of tagged FCS returned to			
								Fisherman	Station	Total	Data 1 Data 2
1988	1987	Large (30/lb.)	-----	100%	53,815	183	125	0.34	0.23	0.57	17 1,2,3,4,5,6,7,8
1988	1987	Small (64/lb.)	-----	100%	64,508	90	49	0.14	0.08	0.22	17 9,10,11,12,14,15
1989	1987	Oahe Dam (3.3/lb.)	-----	100%	6,235	44	2	0.71	0.03	0.74	17 16
1989	1987	Whitlocks (3.3 lb.)	-----	100%	6,250	28	67	0.45	1.07	1.52	17 18
1989	1988	Whitlock Stock (44/lb.)	-----	92.60%	31,312	66	93	0.21	0.30	0.51	18 22
1989	1988	Direct Stock (34.5/lb.)	-----	100%	30,164	83	146	0.28	0.48	0.76	18 23
1990	1989	WBS/Fall Stock (8/lb.)	-----	74.80%	10,300	93	108	0.90	1.05	1.95	17 19
1990	1989	WBS/(53/lb.)	-----	100%	29,019	114	106	0.39	0.37	0.76	19 26,27
1991	1989	WBS (2.9/lb.)	-----	76.99%	11,990	177	381	1.48	3.18	4.65	19 24
1991	1990	WWB Direct Stock (45/lb.)	-----	100%	19,242	107	106	0.56	0.55	1.11	20 28,29,30
1991	1990	WBS Stock	-----	100%	17,850	82	114	0.46	0.64	1.10	20 31,32,33,34
1992	1991	WWB (30/lb.)	-----	89.50%	30,193	186	199	0.62	0.66	1.28	21 1,2
1992	1991	WWB (runts; 60.5/lb.)	-----	86.00%	2,623	2	15	0.08	0.57	0.65	21 3
1993	1992	WWB (34/lb.; Direct stock)	-----	92.50%	22,959	169	220	0.74	0.96	1.69	22 1,2,3
1993	1992	WWB (51/lb.)	-----	80.00%	18,430	104	108	0.56	0.59	1.15	22 4,5,6,7
1994	1993	WWB (29.6/lb.)	210,656	82.80%	47,973	269	379	0.56	0.79	1.35	23 1,2,3,4,5,6
1995	1994	WWB (27.9/lb.)	212,999	98.00%	48,469	65	87	0.13	0.18	0.31	24 1,2,3,4,5,6
1996	1995	WWB (32.5/lb.)	237,217	86.00%	46,394	10	18	0.02	0.04	0.06	25 1,2,3,4,5,6
1997	1996	WWB (38.9/lb.)	243,278	80.50%	50,428	23	96	0.05	0.19	0.24	26 1,2,3,4,5,6
1998	1997	WWB (34.5/lb.)	126,144	82.10%	28,822	7	14	0.02	0.05	0.07	27 1
1998	1997	WWB (9.41/lb.)	47,696		19,315	4	28	0.02	0.14	0.17	27 2
1999	1998	WWB (43.13/lb.)	54,772	99.00%	14,519	-	3	0.00	0.02	0.02	28 1
1999	1998	WWB (40.24/lb.)	54,772	97.10%	15,745	2	26	0.01	0.17	0.18	28 2
1999	1998	WWB (8/lb.)	50,204	98.60%	9,686	2	59	0.02	0.61	0.63	28 3
1999	1998	WWB (8.12/lb.)	50,204	98.30%	9,685	2	55	0.02	0.57	0.59	28 4
2000	1999	WWB (8.61/lb.)	24,597	99.00%	14,850	4	180	0.03	1.21	1.24	29 1
2000	1999	WWB (8.46/lb.)	24,582	98.90%	14,835	-	116	0.00	0.78	0.78	29 2
2001	2000	None									
2002	2001	None									
2003	2002	WWB (33.7/lb.)	5,688	39.20%	2,230	1	5	0.04	0.22	0.27	25, 28 8, 6
2003	2002	WWB (33.6/lb.)	4,403	87.50%	3,853	1	15	0.03	0.39	0.42	22 6, 8
2003	2002	WWB (8.4/lb.)	4,368	25.10%	1,096		22	0.00	2.01	2.01	22 9
2004	2003	WWB (33.7/lb.)	13,528	82.00%	11,093			0.00	0.00	0.00	29 3
2004	2003	WWB (33.6/lb.)	14,295	83.30%	11,908		1	0.00	0.01	0.01	29 4
2004	2003	WWB (84.4/lb.)	6,303	Not available	6,303			0.00	0.00	0.00	26 11

Portions in gray are still being created

Appendix I.

Estimated contribution of North Dakota Chinook salmon to South Dakota spawning operations on Lake Oahe during 2004.

ID code	State	Year stocked	Brood year	Stocking size /lb.	ND FCS No. CWT	No. fish captured	% CWT returned	Total No. stocked	Est. No. of ND FCS fall of 04
2-1	ND	2002	2001	50	14,000	3	0.02143	98,283	21
2-3	ND	2002	2001	50	14,000	1	0.00714	250,554	18
2-11	ND	2003	2002	45	15,000	1	0.00667	202,965	14
2-12	ND	2003	2002	65	15,000	3	0.02000	97,500	20
TOTALS					58,000	8			72

Total FCS collected fall 04	Est. No. of ND FCS fall of 04	Estimated % of ND FCS collected during SD Spawn
170	72	42.35%

Note: Data used in calculations from Jason Lee, North Dakota Fish and Game Department.

Appendix J. Summary of South Dakota, North Dakota and Montana Chinook salmon total egg take efforts and egg transfers among states.

Year	No. of eggs taken in SD	No. of eggs taken in ND	No. of eggs taken in MT	No. of excess eggs given to ND from SD	No. of excess eggs given to MT from SD	No. of excess eggs given to SD from ND	No. of excess MT from ND
1980		90,000					
1981	100,000	400,000					
1982		Unknown					
1983		N/A					
1984	81,340	395,000					250,000
1985	364,900	379,700					
1986	186,746	479,600					177,413
1987	871,137	2,403,000					
1988	667,796	933,234					55,940
1989	418,160	739,350					
1990	787,708	1,574,269					101,210
1991	453,864	654,280					
1992	992,630	1,087,500			112,000		
1993	1,744,100	392,000		677,200			
1994	1,542,180	381,700		502,500	50,000		37,000
1995	1,969,162	547,650		849,000	240,000		
1996	1,054,841	1,570,130	390,000	228,000			
1997	558,945	1,126,406				50,000	
1998	498,100	749,116	6,000		49,561		
1999	316,862	3,038,219	141,000		193,000 ^a		250,000
2000	155,700	2,203,638			54,925		344,393
2001	153,264	2,400,322			43,150		600,000
2002	1,192,372	2,005,380	64,000		350,800 ^b		
2003	1,162,372	644,242	231,645	311,200	186,366		
2004	33,120	1,756,000				407,846	200,000 ^c
Total	15,305,299	25,950,736	832,645	2,567,900	1,279,802	457,846	2,015,956
Average	695,695	1,128,293	166,529	513,580	142,200	228,923	223,995

^a Includes 100,000 eggs collected from Cleghorn Springs Hatchery brood stock

^b Includes 200,000 fingerling raised for MT;

^c Fingerlings raised in SD hatchery for MT, eggs from ND

Length at selected number per pound values for rainbow trout

Note: These values come from condition factor averaged from
Thousand of hatchery fish measured and weighed and are to be considered with
A grain of salt for wild fish.

Condition Factor (C)	Number per lb.	Individual Weight lb.	Length (inches)	C is based On English Measurements (Pounds and Inches)	
0.0004	2500.00	0.0004	1.0		
0.0004	740.74	0.0014	1.5	Excel equation to calculate length from a known number/pound.	
0.0004	312.50	0.0032	2.0	$=10^{((\text{LOG}(1000/\#/\text{LB.})-\text{LOG}(\text{Cond Factor}*1000))/3)}$	
0.0004	160.00	0.0063	2.5	To calculate length in inches enter number/lb here	10
0.0004	92.59	0.0108	3.0	and condition factor (C) here	0.0004
0.0004	58.31	0.0172	3.5	Length in Inches =	6.30
0.0004	39.06	0.0256	4.0		
0.0004	27.43	0.0365	4.5		
0.0004	20.00	0.0500	5.0		
0.0004	15.03	0.0666	5.5		
0.0004	11.57	0.0864	6.0	Excel equation to calculate individual fish weight from a known Length	
0.0004	9.10	0.1099	6.5	$=\text{Cond. Factor}*(\text{Length}^3)$	
0.0004	7.29	0.1372	7.0	To calculate number/lb enter length (inches) here	6.30
0.0004	5.93	0.1688	7.5	and condition factor (C) here	0.0004
0.0004	4.88	0.2048	8.0	Weight per fish =	0.1000
0.0004	4.07	0.2457	8.5	Number per Pound =	9.9981
0.0004	3.43	0.2916	9.0		
0.0004	2.92	0.3430	9.5		
0.0004	2.50	0.4000	10.0		

Length at selected Number per Pound values for Chinook Salmon

Note: These values come from condition factor averaged from
thousand of hatchery fish measured and weighed and are to be considered with
a grain of salt for wild fish.

Condition Factor	Number per lb.	Individual weight lb.	Length (inches)	Guide to selecting Condition Factor (C) For various Fish Species	
0.0003	3333.33	0.0003	1.0		
0.0003	987.65	0.0010	1.5		
0.0003	416.67	0.0024	2.0	Condition Factor (C)	Species
0.0003	213.33	0.0047	2.5	0.000150	Muskellune and Tiger Muskie
0.0003	123.46	0.0081	3.0	0.000200	Northern Pike
0.0003	77.75	0.0129	3.5	0.000250	Lake Trout
0.0003	52.08	0.0192	4.0	0.000300	Chinook Salmon, Walleye, Channel Catfish
0.0003	36.58	0.0273	4.5	0.000350	Cutthroat, Coho
0.0003	26.67	0.0375	5.0	0.000400	Rainbow, brook and brown trout
0.0003	20.04	0.0499	5.5	0.000450	Large Mouth bass
0.0003	15.43	0.0648	6.0		
0.0003	12.14	0.0824	6.5		
0.0003	9.72	0.1029	7.0		
0.0003	7.90	0.1266	7.5		
0.0003	6.51	0.1536	8.0		
0.0003	5.43	0.1842	8.5		
0.0003	4.57	0.2187	9.0		
0.0003	3.89	0.2572	9.5		
0.0003	3.33	0.3000	10.0		

Haskell, David G. 1959. Trout growth in hatcheries. New York Fish and Game Journal, Vol. 5, no. 2, pp. 204 - 237.

Appendix L. Chinook salmon carcass contract results for 2004.

<u>Date</u>	<u>Number of salmon received</u>	<u>Pounds of fish received</u>	<u>Bid price/lb</u>	<u>Total</u>
Oct. 6, 2004 39 217 \$0.10 \$ 21.70	Oct. 13, 2004 20 129 \$0.10 \$ 12.90	Oct. 26, 2004	72	
	413	\$0.10 \$ 41.30		
<u>Total:</u>	<u>131</u>	<u>759</u>		<u>\$75.90</u>
2004 revenue generated from the <u>sale of salmon carcasses:</u>				\$75.90